



# Imperial Irrigation District Water Conservation and Transfer Project

## Final Environmental Impact Report/ Environmental Impact Statement



### Volume 2



Prepared for



Imperial Irrigation District



U.S. Bureau of Reclamation

Prepared by



**CH2MHILL**

October 2002

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*Final Environmental Impact Report/  
Environmental Impact Statement*

**Imperial Irrigation District  
Water Conservation and Transfer Project**

**VOLUME 2 of 6  
(Section 3.3 – Section 9.23)**

*See Volume 1 for Table of Contents*

Prepared for  
**Bureau of Reclamation  
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SECTION 3.3

## **Geology and Soils**

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## 3.3 Geology and Soils

### 3.3.1 Introduction and Summary

Table 3.3-1 summarizes the geology and soils impacts for the Proposed Project and Alternatives.

TABLE 3.3-1  
Summary of Geology and Soils Impacts<sup>1</sup>

<b>Proposed Project: 300 KAFY All Conservation Measures</b>	<b>Alternative 1: No Project</b>	<b>Alternative 2: 130 KAFY On-farm Irrigation System Improvements Only</b>	<b>Alternative 3: 230 KAFY All Conservation Measures</b>	<b>Alternative 4: 300 KAFY Fallowing Only</b>
<b>LOWER COLORADO RIVER</b>				
No impacts.	Continuation of existing conditions.	No impacts.	No impacts.	No impacts.
<b>IID WATER SERVICE AREA AND AAC</b>				
<b>GS-1: Soil erosion from construction of conservation measures:</b> Less than significant impact.	Continuation of existing conditions.	<b>A2-GS-1: Soil erosion from construction of conservation measures:</b> Less than significant impact.	<b>A3-GS-1: Soil erosion from construction of conservation measures:</b> Less than significant impact.	<b>A4-GS-1: Soil erosion from fallowing:</b> Less than significant impact with mitigation.
<b>GS-2: Soil erosion from operation of conservation measures:</b> Less than significant impact.	Continuation of existing conditions.	No impact.	<b>A3-GS-2: Soil erosion from operation of conservation measures:</b> Less than significant impact.	No impact.
<b>GS-3: Reduction of soil erosion from reduction in irrigation:</b> Beneficial impact.	Continuation of existing conditions.	<b>A2-GS-2: Reduction of soil erosion from reduction in irrigation:</b> Beneficial impact.	<b>A3-GS-3: Reduction of soil erosion from reduction in irrigation:</b> Beneficial impact.	No impact.
<b>GS-4: Ground acceleration and shaking:</b> Less than significant impact.	Continuation of existing conditions.	<b>A2-GS-3: Ground acceleration and shaking:</b> Less than significant impact.	<b>A3-GS-4: Ground acceleration and shaking:</b> Less than significant impact.	No impact.
<b>GS-5: Soil Erosion from compliance with the IOP:</b> Less than significant impact.	Continuation of existing conditions.	<b>Same as GS-5.</b>	<b>Same as GS-5.</b>	<b>Same as GS-5.</b>

TABLE 3.3-1  
Summary of Geology and Soils Impacts<sup>1</sup>

<b>Proposed Project: 300 KAFY All Conservation Measures</b>	<b>Alternative 1: No Project</b>	<b>Alternative 2: 130 KAFY On-farm Irrigation System Improvements Only</b>	<b>Alternative 3: 230 KAFY All Conservation Measures</b>	<b>Alternative 4: 300 KAFY Following Only</b>
<b>HCP-IID-GS-6: Soil erosion from construction of HCP components:</b> Less than significant impact.	Continuation of existing conditions.	Same as HCP-IID-GS-6.	Same as HCP-IID-GS-6.	Same as HCP-IID-GS-6.
<b>SALTON SEA</b>				
<b>GS-7: Potential for increased soil erosion along exposed playa of Salton Sea:</b> Less than significant impact.	Continuation of Baseline conditions.	<b>A2-GS-4: Potential for increased soil erosion along exposed playa of Salton Sea:</b> Less than significant impact.	<b>A3-GS-5: Potential for increased soil erosion along exposed playa of Salton Sea:</b> Less than significant impact.	<b>A4-GS-2: Potential for increased soil erosion along exposed playa of Salton Sea:</b> Less than significant impact.
<b>SDCWA SERVICE AREA</b>				
No impact.	Continuation of existing conditions	No impact.	No impact.	No impact.

<sup>1</sup> Programmatic level analyses of USFWS' biological conservation measures in LCR subregion. Subsequent environmental documentation will be required if potential impacts are identified.

### 3.3.2 Regulatory Framework

**Alquist-Priolo Earthquake Fault Zone Act.** The Alquist-Priolo Earthquake Fault Zone Act (Public Resources Code Sections 2621 *et seq.*) was passed in 1972 to prevent buildings from being constructed astride active faults. The act was prompted by damage attributable to surface faulting in the 1971 San Fernando earthquake and the lack of geologic information.

The act is designed to mitigate surface fault rupture by preventing construction of buildings for human occupancy across an active fault. It requires state zoning of active faults, and local review and regulation of development within the zones. The act does not address power lines, water lines, or roads unless there are associated structures for human occupancy that would exceed 2,000 person hours per year (Bryant 2001).

Several of the fault zones in Southern California are considered active by the California Department of Conservation Division of Mines and Geology (CDMG). Alquist-Priolo special study zones (A-P zones) have been established for the majority of these faults and fault zones in accordance with the Alquist-Priolo Special Studies Zones Act of 1972 (CDMG 1983). A-P zones are areas established along and parallel to the traces of active faults. The delineation of A-P zones on topographic maps is the responsibility of CDMG.

The purpose of A-P zones is to prohibit the location of structures on the traces of active faults, thereby mitigating potential damage from fault surface rupture.

**Seismic Hazards Mapping Act.** The Seismic Hazards Mapping Act and related regulations establish a statewide minimum public safety standard for mitigation of earthquake hazards (CDMG 1994). According to this act, the minimum level of mitigation for a project should reduce the risk of ground failure during an earthquake to a level that does not cause the collapse of buildings for human occupancy, but, in most cases, not to a level of no ground failure at all. Nothing in the act precludes public agencies from enacting more stringent requirements, or from requiring a higher level of performance.

**Local Regulations and Standards.** Imperial County and Riverside County general plans contain goals and policies for protection of geologic features, soil resources, and avoidance of geologic hazards. Additionally, building codes and grading ordinances establish specific regulations for construction procedures, including erosion control measures.

### 3.3.3 Existing Setting

#### 3.3.3.1 Lower Colorado River

##### GEOLOGY

The LCR geographic subregion exists within the Sonoran Desert of the basin and range geomorphic province, which is characterized by barren, rugged mountains separated by broad, desert alluvial basins. Landforms in the area are grouped as mountains and hills, piedmont slopes and dissected uplands, sand dunes, and river floodplains (Ratdke et al. 1988). In the LCR geographic subregion, the Colorado River channel cuts undivided Quaternary alluvium; mostly well-consolidated Oligocene sandstone, shale, and conglomerate; a variety of undivided pre-Cenozoic metasedimentary and metavolcanic rocks; Tertiary sandstone, shale, conglomerate, and breccia; Tertiary pyroclastic, volcanic flow, and volcanic mudflow deposits; Tertiary intrusives; Mesozoic and Paleozoic schists; and Precambrian basement rock (Jennings et al. 1991).

##### SOILS

Soils along the LCR vary from excessively-drained to well-drained fine sand loam, silty clay loam, loamy fine sand, fine sand, gravelly loamy sand, and very fine sand loam that have formed in alluvium deposited by the Colorado River, in alluvium on valley floors, and on old alluvial fans. The following soil associations are present along the LCR: Gilman-Rositas-Indio, Gunsight-Rillito-Chuckwalla, and Badlands-Rositas-Beeline (University of Redlands 1999).

##### SEISMICITY/GEOLOGIC HAZARDS

Seismogenic sources in Imperial and Riverside Counties include the San Andreas, San Jacinto, Imperial, and Cerro Prieto fault zones and the Mojave shear zone, which are located in the western Mojave Desert (Bausch and Brumbaugh 1996, 1997).

**Ground Acceleration and Ground Shaking.** Ground acceleration is an estimation of the peak bedrock or ground motion associated with a specific earthquake and is expressed in terms of a percentage of gravitational acceleration. The level of destruction of an earthquake at a particular location is commonly reported using a seismic intensity scale. Because seismic

intensities are based on past reports of ground shaking and damage, they are subjective classifications. The commonly used Modified Mercalli Intensity (MMI) scale has 12 levels of intensity (I through XII). The higher the number, the greater the ground-shaking intensity and/or damage. Earthquakes have only one magnitude, but they have variable intensities that generally decrease with increasing distance from the source. Additionally, other factors, such as building type, shallow groundwater, and local geology, affect the intensities of earthquakes at a particular location.

The San Andreas, San Jacinto, Imperial, and Cerro Prieto fault zones, as well as the Mojave shear zone, represent the greatest ground-shaking hazard to the LCR geographic subregion. The 1940 Imperial Valley earthquake resulted in shaking effects in La Paz County, Arizona, including MMI VI and V effects at Parker and Quartzsite, respectively. In Yuma, Arizona, MMI X effects were noted approximately 50 miles from the epicenter (Bausch and Brumbaugh 1996, 1997).

**Fault Rupture.** Fault rupture refers to the physical displacement of surface deposits in direct response to movement along a fault. As described above, several fault and shear zones could contribute to ground-shaking hazards along the LCR; however, the LCR is not underlain by a potentially active fault or shear zone such that fault rupture would be likely to occur (see Figure 3.3-1) (Bausch and Brumbaugh 1997).

**Liquefaction.** Liquefaction occurs when earthquake vibrations cause loose, granular silts or sands that are saturated with groundwater to transform from a solid into a liquid state.

Areas along the LCR 100-year floodplain and stream valleys that are underlain by relatively unconsolidated soil and shallow groundwater could be susceptible to liquefaction-induced ground failure in an earthquake. Low-lying irrigated regions, such as the Parker Valley, are especially vulnerable (Bausch and Brumbaugh 1996, 1997). Bausch and Brumbaugh did not report historic liquefaction occurring within La Paz County, but they did report liquefaction in the Yuma Valley south and east of the LCR geographic subregion, buckled bridges and flumes, and rupturing of the extensive canal network.

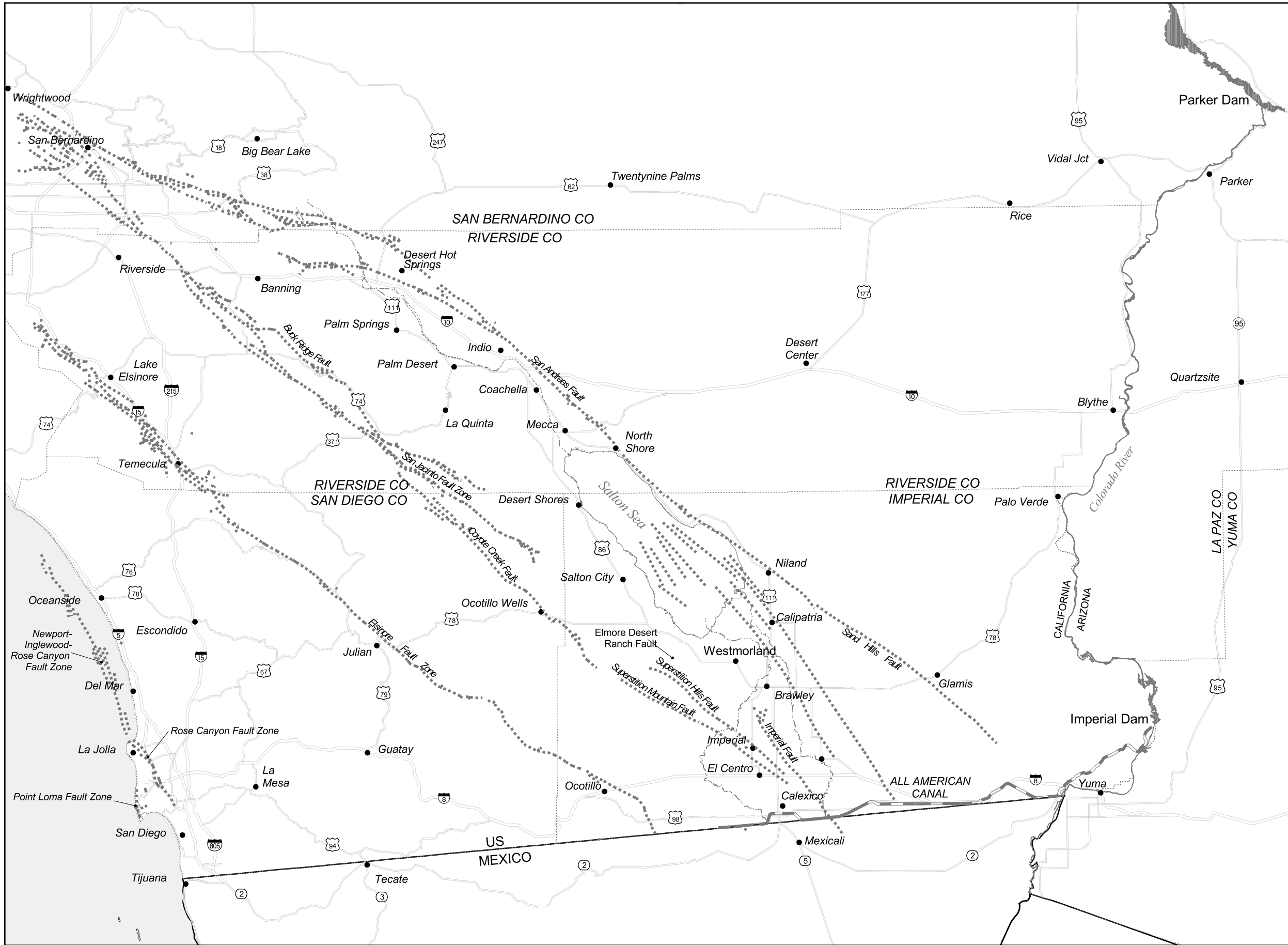
**Landslides.** Potential areas of slope instability have been identified in areas along the LCR. The failure mechanism(s) are not understood at this time (Bausch and Brumbaugh 1996, 1997).

**Seiches.** A seiche is an earthquake-induced wave occurring in any confined body of water, such as a reservoir. No seiches occurring in the Parker Dam to Imperial Dam reach have been reported in the reservoirs (Reclamation 1997).

### 3.3.3.2 IID Water Service Area and AAC

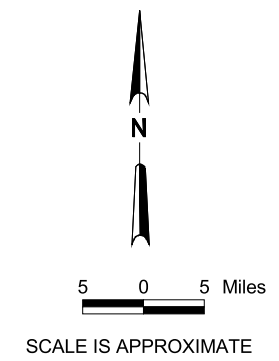
#### GEOLOGY

The entire Imperial Valley Basin lies within the Salton Basin Region of the Salton Trough, a large, sediment-filled topographical depression and seismically active valley that is approximately 130 miles long and as much as 70 miles wide. The Salton Basin Region includes sub-basins and portions of sub-basins (i.e., Imperial Valley and other nearby sub-basins) within the Salton Trough that drain directly into the Salton Sea. The Salton Basin is bordered on the north by the Salton Sea, on the northeast by the Chocolate Mountains, on



- FAULT
- AQUEDUCT/CANAL
- COUNTY LINE
- INTERSTATE HIGHWAY
- REGIONAL HIGHWAY
- INTERNATIONAL BORDER
- RIVER
- CITIES

Sources:  
University of Redlands 1999; DOI 1999;  
and Reclamation 1999



**Figure 3.3-1**  
**Fault Map**  
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the southeast by the Sand Hills and Cargo Muchacho Mountains, on the west by the Vallecito and Jacumba Mountains, and on the south by the northern Mexicali Valley and International Boundary (see Figure 3.1-22 in Section 3.1, Hydrology and Water Quality).

Topographically, the Salton Trough is a broad, flat alluviated valley with an area of about 6,000 square miles. The entire valley lies below 500 feet above sea level, except for its rise into San Geronio Pass. More than 3,000 of its 6,000 square miles are below sea level (from the city of Indio to below the International Boundary). The lowest elevation point in the Salton Trough is 273 feet below sea level, which is the deepest point in the Salton Sea (Singer 1998).

The Salton Trough is filled with approximately 21,000 feet of Cenozoic sediments derived predominantly from the Colorado River, which emptied into the Gulf of California during the Cenozoic period. The sediments formed a delta that spread and eventually separated the Salton Basin Region from the Gulf of California. The Sand Hills are windblown sand deposits that form a 40-mile-long by 5-mile-wide belt of sand dunes extending along the east side of the Coachella Canal from the International Boundary. Within Coachella and Imperial Valleys, an old lake shoreline has been identified by the presence of lacustrine deposits. It is estimated that Lake Coachella covered an area approximately 117 miles long and 30 miles wide. The Imperial Formation, which is marine in origin, underlies the sequence of sedimentary layers within the Salton Basin Region. The Imperial Formation is underlain by igneous and metamorphic basement rocks.

## SOILS

In the dry climate of Imperial County, soils, unless irrigated, have no potential for farming and very limited potential for wildlife habitat (County of Imperial 1997a). Lacustrine basin soils in the IID water service area formed on nearly level old lake beds in the area of ancient Lake Cahuilla. These soils generally consist of silty clays, silty clay loams, and clay loams; are deep and highly calcareous; and usually contain gypsum and soluble salts. The central areas in the IID water service area generally have fine-textured silts, which are primarily used for crops. Continued agricultural use of soils within the IID water service area required installation of subsurface tile drains to carry away water and salts that would have otherwise built up in the soils and prevented crop growth. Tile drains discharge this flow to surface drains (IID 1994). Sandy soils, typical of the deserts in the Southwest US, are predominant at higher elevations, such as the East and West Mesas, and are generally used for recreation and desert wildlife habitat.

Detailed descriptions of the major soil associations, series, and classes in Imperial County can be obtained from the 1981 soil survey of Imperial County (Natural Resources Conservation Service [NRCS] 1981). NRCS' soil survey identified 10 major soil associations that can be generally grouped into two categories based on landscape: well-drained to poorly-drained soils, predominantly in the lacustrine basin (irrigated area); and well-drained and somewhat excessively well-drained soils of the mesas, alluvial fans, terraces, and mountains rimming the basin (NRCS 1981). The distribution of soil associations within the Salton Trough is shown in Figures 3.3-2A and 3.3-2B.

The IID water service area is generally flat, with low levels of natural erosion. Erosion is dependent on texture (i.e., clay, sand, or silt content), moisture content, and agronomic

practices (i.e., cropped, fresh-tilled, or fallow). Figure 3.3-3 illustrates erosion activity throughout Imperial County.

### SEISMICITY/GEOLOGIC HAZARDS

The IID water service area is a flat, broad, alluviated area that lies partly below sea level and is located within the Salton Trough, one of the most tectonically active regions in the U.S. The San Jacinto-Coyote Creek and Elsinore-Laguna Salada fault zones form the western boundary of the Salton Trough. Branches of the San Andreas fault zone (see Figure 3.3-1) form the eastern boundary. The Salton Trough is characterized by northwest southeast-trending transform fault zones with several crustal rift areas between them. The Salton Trough is the northern extension of the Gulf of California rift zone. Consequently, the IID water service area is subject to potentially destructive earthquakes.

Within the Salton Trough, there are numerous major and several less extensive active fault zones that contain a number of individual fault traces. The active and potentially active major faults within the Salton Trough are presented in Figure 3.3-1 and Table 3.3-2.

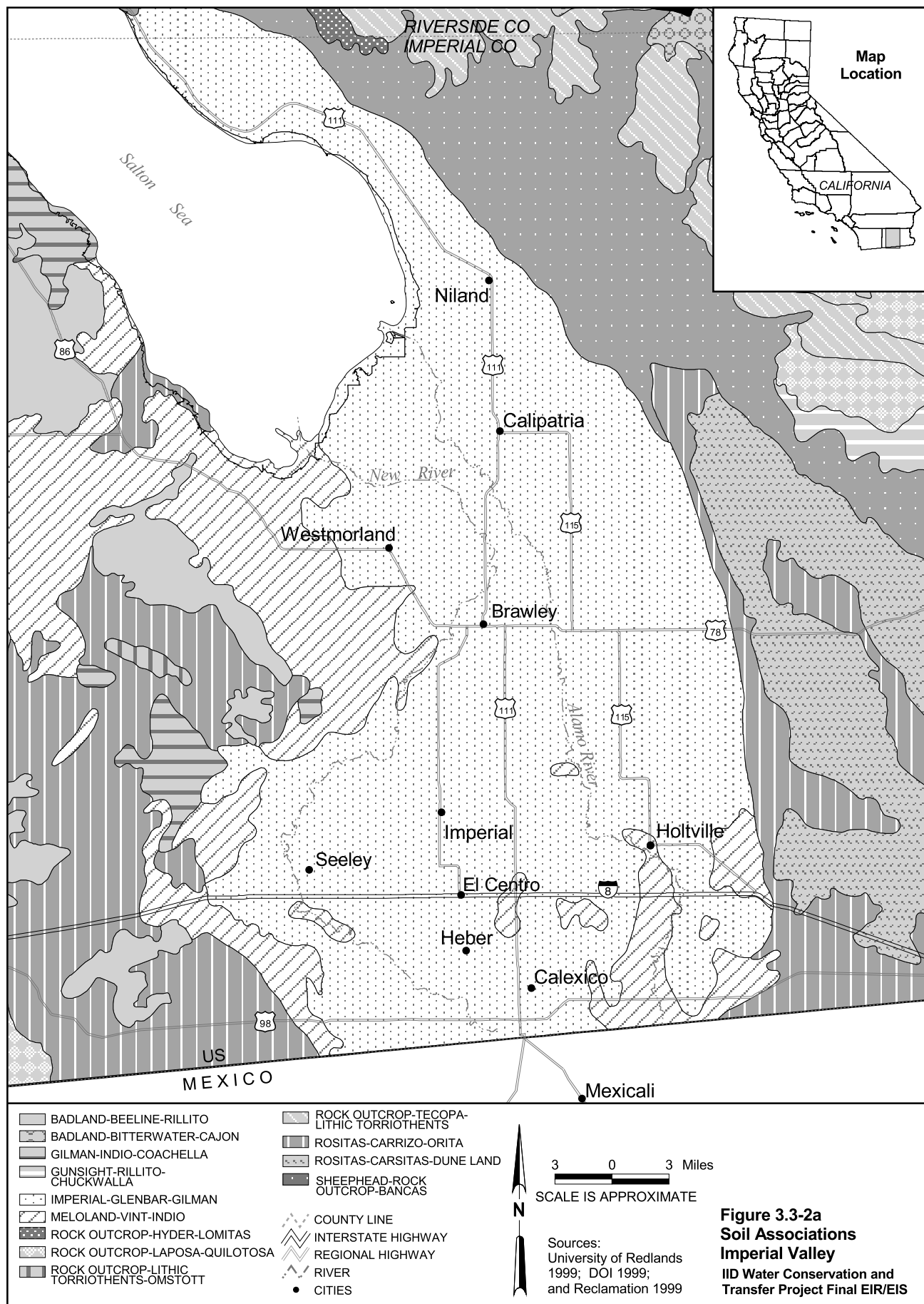
A potentially active fault shows evidence of displacement within the last 1.6 million years; an active fault is one that has experienced surface displacement within the last 11,000 years.

The major fault zones in the area – San Andreas, San Jacinto, and Elsinore (see Figure 3.3-1) – are characterized by right lateral movement. The Brawley fault, and its associated zone of seismicity, includes much of the southeastern portion of the Salton Sea in the northern Salton Trough. During the 1979 Imperial Valley earthquake, surface rupture occurred along several miles of the Brawley fault zone. The Elmore Ranch fault is a relatively short structure that experienced minor surface rupture associated with the 1987 Superstition Hills-Elmore Ranch earthquake sequence. The Elmore Ranch fault, with a mapped length of only about 5 miles, appears to be the western end of a zone of seismicity termed the Elmore Ranch seismic zone, which extends across nearly the entire southern end of the Salton Sea.

TABLE 3.3-2  
Salton Trough Fault Characteristics

Fault	Maximum Credible Earthquake	Estimated Peak Ground Acceleration	Estimated Repeatable High Ground Acceleration	Estimated Maximum Mercalli Scale Intensity
<b>Active Faults</b>				
San Andreas	7.5	0.275	0.180	VIII
Brawley	7.0	0.290	0.190	VIII
Imperial	7.2	0.275	0.180	VIII
Superstition Hills (Elmore Ranch)	7.0	0.60	0.40	IX
San Jacinto (Coyote Creek)	7.2	0.310	0.20	VIII
Elsinore	7.5	0.210	0.210	VIII
<b>Potentially Active Faults</b>				
Calipatria	7.5	0.290	0.190	VIII
Sand Hills	7.5	0.150	0.150	VII
Superstition Mountain	7.0	0.360	0.234	VIII-IX
Laguna Salada	7.25	0.175	0.175	VII-VIII

Source: SSA and Reclamation 2000



**Figure 3.3-2a**  
**Soil Associations**  
**Imperial Valley**  
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